Applying Quadratics
The Basic Tool List

We have studied Quadratic Relations and Equations and have learned many concepts. When applying this knowledge to problems, here are the basic items you will apply:

(1) Finding a Max or Min:
How?
Complete the Square - (h, k) is the max/min
Use your calculator / desmos
~~Partial Factor – solve for a.o.s. and plug in to relation to find y-value~~
Keywords/Phrases/Ideas:
Find the maximum or highest. Find the minimum or lowest. Best. Optimal

(2) Finding any x-value:
How?
Plug the value into the equation
Use 2nd Calc- Value on the Calculator
Keywords/Phrases/Ideas:
Look for the independent variable (x) to be given

(3) Finding any y-intercept:
How?
c in the standard form
plug in x=0 into the Quadratic Relation
Keywords/Phrases/Ideas:
What is the starting value or original value, At what height was the ____ before _____.

(4) Finding the Solution to a Quadratic Equation. Note: this happens when you only have **one** unknown. → no "y"
How? ↳ $0 = ax^2 + bx + c$ ex. $2x = 3x^2 - 4x + 2$
Factoring - set products equal to zero
Solving from Completing the Square – re order the equation
Quadratic Formula
Zeros on the Calculator / **or** finding the point of intersection and plugging the y-value into y_2
↳ Desmos.

Keywords/Phrases/Ideas:
Look for the dependent variable (y) to be given. Look for situations when you have only ONE unknown. When did____ hit he ground.

Applying Quadratics: Outline

Extra from the textbook if you'd like:
Mostly Vertex Apps

- pg 147: 12-14 (calc)
- pg 157: 13-15
- pg 168: 15
- pg 271: 10, 14, 15
- Pg 294: 11, 13-17
- pg 302: 11-14
- pg 331: 8-13(Complete the square)

Mostly Zeros Apps

- pg 321: 11-14
- pg 344: 13-16
- pg 350: 6-8, 11

Mix: pg 358: 3-14

Mr. Fluit throws a ball into the air. The height of the ball can be described by $h=-4.9t^2+14.7t+1.5$, where *h* is the height and *t* is the time in seconds. Without using a calculator, find the following:
a) What height did Mr. Fluit throw the ball from?
b) What was the maximum height of the ball? At what time was that height reached?
c) When did the ball hit the ground?

a) 1.5m : $t=0 \rightarrow h=-4.9(0)^2+14.7(0)+1.5$
$h=1.5$

b) max : vertex! → complete the square.

$h=-4.9t^2+14.7t+1.5$

$h=-4.9(t^2-3t)+1.5$

↳ $\left(\frac{-3}{2}\right)^2=(-1.5)^2=2.25$

$h=-4.9(t^2-3t+2.25-2.25)+1.5$

$h=-4.9(t^2-3t+2.25)+11.025+1.5$

$h=-4.9(t-1.5)^2+12.525$

v (1.5, 12.525)
t h

Max height is 12.525m and it occurred at 1.5 sec.

c) hit the ground? $h=0$

$0=-4.9t^2-14.7t+1.5$

Solve from vertex form

$0=-4.9(t-1.5)^2+12.525$

$\frac{-12.525}{-4.9}=\frac{-4.9(t-1.5)^2}{-4.9}$

$\pm\sqrt{2.56}=\sqrt{(t-1.5)^2}$

$\pm 1.6=t-1.5$

$\pm 1.6+1.5=t$

$t=3.1$ or -0.1

The ball hit the ground at 3.1 seconds!

Rick is into selling Valentine's Cards. He currently sells his cards for \$5 and sells 300/week. He discovers that for every \$0.15 increase, he sells 20 less cards.
a) Write an equation to describe the revenue. -> money coming in
b) He wants to maximize his revenue. What should his new price be?
c) If he needs to make \$1600 per week to keep his family fed, what prices could the cards be?

Cost of a card	# sold	revenue
5	300	\$1,500
+.15 → 5.15	−20 → 280	\$1442
+.15 → 5.30	−20 → 260	\$1378

Let R be revenue and x be the number of \$.15 increases.

a) $(5+.15x)(300-20x)=R$

b) use desmos, or

$1500-100x+45x-3x^2=R$

$-3x^2-55x+1500=R$

complete the square

$-3(x^2+\frac{55}{3}x)+1500=R$

$\hookrightarrow (\frac{55}{3}\div 2)^2=(\frac{55}{6})^2=84$

$-3(x^2+18.\bar{3}x+84-84)+1500=R$

$-3(x^2+18.\bar{3}x+84)+252+1500=R$

$-3(x+\frac{55}{6})^2+1752=R$

$\frac{55}{6}=9.17$ $v(-9.17,1752)$

→ $v(-9.17, 1752)$ (x, R)

Card cost is

$5+.15x$

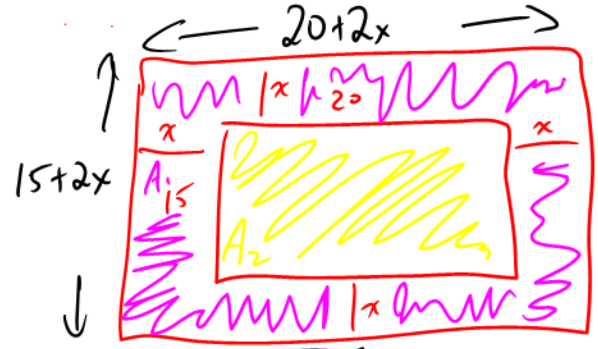
$=5+.15(-9.17)$

$=\$3.62$

sell for \$3.62

c) at bottom of next page.

You have a picture that is 15 cm x 20 cm. You want to add a picture frame around it with UNIFORM width. You would also like the area of the frame to be EQUAL to the area of the picture. What width of frame do you need?



$A_1=A_2$

Area of Picture $=20\times15=300\text{ cm}^2=A_2=A_1$

$A_1+A_2=600\text{ cm}^2$

$A_{whole}=lw$

$600=(15+2x)(20+2x)$

$600=300+30x+40x+4x^2$

$600-600=300-600+70x+4x^2$

$0=4x^2+70x-300$

SOLVE! Quadratic Formula

$x=\frac{-70\pm\sqrt{(70)^2-4(4)(-300)}}{2(4)}$

$=\frac{-70\pm\sqrt{9700}}{8}$

$=\frac{-70\pm 98.5}{8}$

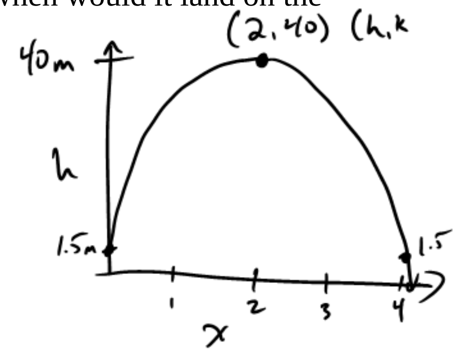
$x=3.56$ or -21.06

The width of the frame is 3.56 cm

A ball is thrown. It hits a maximum height of 40 m at 2 seconds after it was thrown. It was thrown from a height of 1.5 m.

a) Write an equation to describe the balls height over time?
b) When does the ball hit the ground? → $h = 0$
c) If they were throwing the ball onto a building that was 25 m tall, when would it land on the building?

$h = 25$



a) $y = a(x-h)^2 + k$

$y = a(x-2)^2 + 40$

plug in a point $(0, 1.5)$ (x, y)

$1.5 = a(0-2)^2 + 40$

$1.5 - 40 = 4a + 40 - 40$

$-38.5 = 4a$

$\frac{-38.5}{4} = \frac{4a}{4}$

$-9.625 = a$

↳ $y = -9.625(x-2)^2 + 40$

b) $h = 0$

$0 - 40 = -9.625(x-2)^2 + 40 - 40$

solve for x!

$\frac{-40}{-9.625} = \frac{-9.625(x-2)^2}{-9.625}$

$\pm\sqrt{4.16} = \sqrt{(x-2)^2}$

$\pm 2.04 + 2 = x - 2 + 2$

$x = 2.04 + 2$ or $x = -2.04 + 2$

$= 4.04$ $\quad$ $= ~~-0.04~~$

The ball hits the ground at 4.04 seconds.

c) $h = 25$

$25 - 40 = -9.625(x-2)^2 + 40 - 40$

Solve for x!

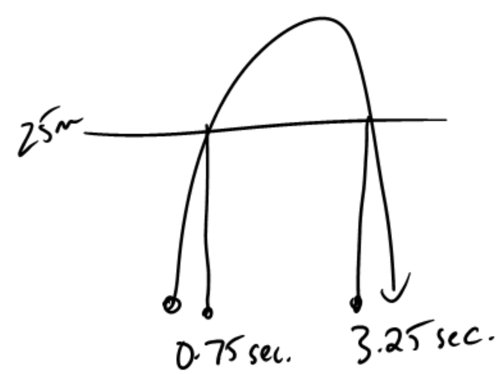
$-15 = -9.625(x-2)^2$

$\pm\sqrt{1.56} = \sqrt{(x-2)^2}$

$\pm 1.25 + 2 = x - 2 + 2$

$x = 1.25 + 2$ or $x = -1.25 + 2$

$x = 3.25$ $\quad$ $x = 0.75$



It lands on the building at 3.25 seconds.